

United States Patent [19]**Gondouin**[11] **Patent Number:** **5,462,120**[45] **Date of Patent:** **Oct. 31, 1995**

[54] **DOWNHOLE EQUIPMENT, TOOLS AND ASSEMBLY PROCEDURES FOR THE DRILLING, TIE-IN AND COMPLETION OF VERTICAL CASED OIL WELLS CONNECTED TO LINER-EQUIPPED MULTIPLE DRAINHOLES**

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[58] **Field of Search:** 166/50, 117.5, 166/117.6, 242, 380, 313, 369; 175/61

[56] **References Cited****U.S. PATENT DOCUMENTS**

1,816,260	• 7/1931	Lee	166/50
2,397,070	• 3/1946	Zublin	166/50
2,492,079	• 12/1949	Wiley	166/117.5
3,330,349	• 7/1967	Owsley et al.	166/117.5 X
4,396,075	• 8/1983	Wood et al.	175/79
4,396,230	• 8/1983	Wood et al.	166/313 X
4,415,205	• 11/1983	Rehm et al.	166/50 X
4,489,782	• 12/1984	Perkins	166/50 X
4,573,541	• 3/1986	Jesse et al.	166/117.5 X
4,742,871	• 5/1988	Miffre	166/117.5
5,052,482	• 10/1991	Gondouin	166/50
5,085,275	• 2/1992	Gondouin	166/303
5,115,872	• 5/1992	Brunel et al.	166/117.5 X

5,127,457 • 7/1992 Stewart et al. 166/50 X

Primary Examiner—Hoang C. Dang[57] **ABSTRACT**

Single horizontal wells drilled through heterogeneous reservoirs are capable of greater oil productivity than vertical wells, often with lower produced GOR and WOR. Multiple drainholes tied-in to a vertical cased well are even more beneficial. Completion of such drainholes in many sandy reservoirs must use cemented liners. Well configurations comprising multiple drainholes liners, each of them tied-in to a vertical casing by pressure-tight connections require novel technologies making use of some novel downhole equipment, tools and procedures for drilling, tie-in and completion of such wells. These may be for newly-drilled wells or may be obtained by re-entry into an existing vertical cased well. Specific equipment, including novel casing joints, whipstocks, intermediate liners and tubing completion assembly components applicable to new wells are described herein. Equipment comprising novel casing inserts and patches applicable to re-entry wells, and the corresponding tubing completion assembly components for a variety of well exploitation modes are also described, together with the required tools and procedures. The liners of the drainholes are such that known well logging and cleaning tools may be used throughout the well's life. The various tubing completion assemblies can all be run-in and installed in a single trip. They allow either commingled flow from all drainholes or selective injection into some drainholes while others are under production. They are adapted to a variety of reservoir pressure conditions and of oil types, including heavy oil produced by sequential "huff and puff" steam injection. EA

7 Claims, 31 Drawing Sheets